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The Efficiency of Implementation of the Developed Guaranteed Training Technology in the Course "Economic and Mathematical Methods and Models"

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ABSTRACT
The purpose of the research is to theoretically and methodically justify the adaptation of the guaranteed training technology in the course of economic and mathematical modeling.
Research methodology and methods. The object of the research is the process of implementing the guaranteed training technology developed by the author of the article based on the methodology of the teacher-scientist V.M. Monakhov. In this pedagogical technology, the information model of the educational process is built with the help of five parameters: goal setting, diagnostics, dosing of students' independent activity, logical structure, and correction.
Research result. The hypothesis of the research on the effectiveness of the introduction of guaranteed training technology in the discipline "Economic and mathematical methods and models" is proved. The effectiveness of using technological maps and information maps of classes in the educational process is confirmed by the results of implementation.
Discussion and conclusion. The analysis of the implementation of the guaranteed training technology in the course of economic and mathematical modeling in the educational process made it possible to find out that it effectively affects the students' acquisition of theoretical and practical educational material. The practical significance of the research is to use the material of the article in teaching the course "Economic and mathematical methods and models" in other universities. In the future, it is necessary to solve the problem of creating a complete, logically consistent classification of pedagogical technologies, so that teachers can freely navigate existing teaching technologies and apply them in practice.

Keywords: *Educational technology, Guaranteed learning technology, Economic and mathematical modeling course, Development of educational materials.*

1. INTRODUCTION

For the development of any professional education, the use of traditional methods in the educational process is insufficient, so at the present stage, the role of pedagogical and information technologies has increased, which harmoniously complement traditional education in higher education institutions. Solving the problem of introducing pedagogical technology into the educational process contributes to the formation of general professional competencies of students; the development of mental potential; the formation of the ability to work independently; increasing students' motivation and activity for educational activities.

The opinion of the teacher-scientist V. M. Monakhov on the functioning of pedagogical technologies in education is interesting. "We should pay attention to the fact that a lot is said and published about pedagogical technologies, especially about the integration of pedagogical and information technologies (by the way, dozens of monographs have already been published about nothing), but in fact, pedagogical technologies have not worked in Russian education" [1, pp.68-69]. A.Zh. Zhafyarov notes that "... pedagogical science rarely brought its developments to technology" [2, p. 106]. The

above mentioned and the statements of teachers-scientists draw attention to the urgency of the problem of introducing pedagogical technology into the educational process.

Pedagogical technology emerged as a trend in the 60s of the XX century in the USA and England (B.F. Skinner [3], B. Bloom [4], D. Bruner [5]) and has been distributed in many countries of the world. In Russia, the theory and practice of implementing pedagogical technologies is reflected in the works of V.I. Andreev, Yu.K. Babansky, V.P. Bespalko, P.Ya. Galperin, M.V. Klarin, N.F. Talyzina, P.M. Erdniev, M.A. Choshanov and others.

Information technologies are widely used in the educational process. University teachers develop e-courses in academic disciplines and use them in the educational process. These materials are stored in the Moodle distance learning system. It is known that if distance learning is implemented together with active forms, students' academic performance increases compared to traditional forms of education. It is reflected in the works [6-10].

The technologies for teaching Economics students the discipline "Mathematics in Economics" is the subject of a PhD thesis by L.N. Orazbekova, and the article by E.M. Arkhipova [11] describes a technological approach to designing the course "Mathematical analysis" for students of economic specialties. Both authors use the methodology of V.M. Monakhov in the field of creating pedagogical technologies, but if the thesis of L.N. Orazbekova designs a course of higher mathematics consisting of several sections, then in the article of E. M. Arkhipova a course of mathematical analysis of a function of one real variable is worked out.

A.V. Babayan states that "the number of teachers seeking to technologize the educational process is increasing" [12, p.92]. But at the same time, he emphasizes that "nevertheless, the effectiveness of some teachers remains low due to the complexity of direct use of scientific ideas and advanced pedagogical experience; insufficient development of the theory of pedagogical technology" [12, p.92]. And then A.V. Babayan indicates an important problem: "The problem of creating a complete, logically consistent classification of pedagogical technologies in order to organize and systematize the variety of existing technologies so that teachers can freely navigate the existing "fan" of technologies and apply them in practice" [12, p.94].

D.A. Vlasov, considering the general issues of technologization of the higher education system, points out the difficulties in the development and implementation of pedagogical technologies: "Among the problems in the field of higher education it is necessary to highlight the theoretical problems and problems of practical implementation in the educational process (at the level of the educational program as a whole, at the level of the educational area, at the level of the discipline, at the classroom level, etc.):

- problems in the field of technological goal setting;
- problems of selecting the training content;
- problems of choosing a strategy for the development of a methodological training system;
- problems of selecting typical tasks of the training course;
- problems of integration of information and pedagogical technologies;
- problems of choosing visualization tools for learning content elements;
- problems of application of information technologies, etc." [13, p.2].

And then D.A. Vlasov offers: "To optimize further work, it is necessary to create a kind of professional guide covering various educational fields ("Mathematics", "Computer Science", "Economics", "Management", "Finance", etc.) with a wide range of research and complete practical recommendations on the use of new pedagogical technologies in the practice of preparing bachelors and masters in higher education" [13, p.2]. The ideas of D.A. Vlasov and A.V. Babayan on this issue are similar.

The purpose of this article was to find out how the guaranteed training technology in the course of economic and mathematical modeling is adapted in the educational process, which provides effective training of students in this discipline, which contributes to improving the quality of professional knowledge of future economists.

2. RESEARCH METHODOLOGY AND METHODS

The author of this article [14] developed the guaranteed training technology in the course "Economic and mathematical methods and models" by V.M. Monakhov, selected the most significant content of this discipline and structured the educational material [15]. Then, based on these works and the methodology of pedagogical technology, conceptually justified by V.M. Monakhov in his works [16-21], the guaranteed training technology in the course "Economic and mathematical methods and models" was introduced into the educational process.

The introduction of pedagogical technology was carried out according to the working curriculum for students of the specialty "Economics" of the Faculty of Economics of Eurasian National University named after L.N. Gumilyov during the semester (15 weeks): lectures – 30 hours, practical classes – 15 hours, independent work of students – 90 hours. The components of the thematic plan of the working curriculum of the discipline

are three topics [14]. On these topics, according to the methodology of V.M. Monakhov's pedagogical technology, the author of the article developed the technological maps [14]. The technological maps were issued to the students at the first lesson.

Five parameters of the educational process characterize the technological map: goal setting, diagnostics, dosage of independent activity of students, logical structure and correction. Each parameter of the educational process is described separately in the works of V.M. Monakhov.

By diagnostics, the fact of achievement or failure to achieve a specific micro-goal is established. The diagnostics includes 4 tasks. The teacher should take a responsible approach to the selection of these tasks. The first two tasks should be selected in such a way that their successful completion indicates that the student's knowledge meets the requirements of the "satisfactory" standard. All students in the group are required to complete these tasks. For the correct solution of the third task, the rating is "good", and for the solution of the fourth task – "excellent". If a student makes mistakes when completing the first two tasks, then a system of pedagogical measures is in place to bring the student to the level of the standard requirements. It happens that a student completed one of the tasks, but made a mistake in the other, then he is preparing for diagnostics according to the tasks of the "Dosing of homework" block from the technological map. If the amount of homework is completed at the level of the standard requirements and the error in the diagnosis is not repeated, the student receives a "satisfactory" rating [18].

During the first 7 weeks, the first topic "Linear programming tasks" was completed. The next 3 weeks (8, 9, 10) were devoted to the second topic "Graphic networks and matrix games". The third topic "Nonlinear and dynamic programming, queuing systems" was studied starting from the 11th week until the end of the semester. The students were awarded points for diagnosis 1 in the third week. In the sixth week, the students reported on diagnosis 2, in the eighth week – on diagnosis 3, in the tenth week – on diagnosis 4, and in the thirteenth week – on diagnosis 5. When receiving an "unsatisfactory" rating or to improve the results of diagnostics, the students solved tasks from the dosage of homework and submitted them to the teacher for the checking. Since the students' acquisition of the topics from the developed guaranteed training technology was checked with the help of the diagnostics 1, 2, 3, 4, 5 and each of them included 4 tasks, it was decided to take the average values of the results from the diagnostics 1, 2 for each student as the results of boundary control 1. The average values of the results for each student in the diagnostics 3, 4, and 5 served as the results of boundary control 2. This decision was made because, firstly, the tasks from the course "Economic and mathematical methods and models" are voluminous and one classroom session is not enough to assess knowledge at the boundary control, and secondly, the diagnostic tasks performed by the students are checked and evaluated by the teacher.

The technology for guaranteed training in the discipline "Economic and mathematical methods and models" was adapted with some changes. In the process of implementation, the compiled technological maps had to be coordinated with the requirements of the educational process, in particular, with the schedule of classes. It was necessary to make adjustments to the diagnostics, i.e. to exclude from the diagnostics the task of drawing up a mathematical model of the traveling salesman problem on the topic "Graphic networks and matrix games". The adjustments were also made to the logical structure of the educational process. Within one topic in the technological map, the hours were redistributed between lectures and practical classes. For example, on the topic "Linear programming tasks" for practical classes on solving dual linear programming tasks, as well as on solving tasks using the artificial basis method, 1 hour was allocated from lectures on the simplex method and the transport tasks. The dosage of homework was made from collections of tasks in the discipline "Economic and mathematical methods and models".

3. THE RESULTS OF THE STUDY

The level of acquired knowledge, skills and abilities was determined based on the results of current and mid-term controls, as well as the exam. The matrix testing was used at the exam for the course "Economic and mathematical methods and models". The students were given the tests, each of which contained 25 tasks with multiple choice answers. There was one correct answer among them. The final score in points was determined by the formula

$$И = \frac{Р1+Р2}{2} \times 0.6 + Э \times 0.4 , \quad (1)$$

here P1 and P2 are the results of two ratings, which consisted of points for the current control and boundary control, and Э is the exam score in points.

Table 1 shows that diagnosis 1 received an average score of 74.6, corresponding to the traditional rating of "3". Average scores corresponding to the "4" rating were revealed by diagnostics 2 (77.8), diagnostics 3 (81.9), diagnostics 4 (83), diagnostics 5 (76). Figure 1 shows that the average scores increase from diagnosis 1 to diagnosis 4. Then we observe a decrease in the average score to 76 for diagnosis 5. This happened at 12-13 weeks and is explained by the fact that on the 13th week, the students were distracted from passing 4 tasks on diagnostics 5 due to preparation for boundary controls in other academic disciplines. According to the results of diagnostics, group

4 achieved an average value of 83 points, which is the highest.

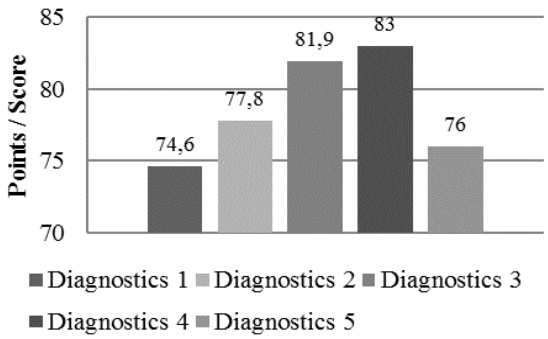

Figure 1 Average scores for five diagnostics.

The results of students in points for five diagnostics, two boundary controls and an exam are included in the journal of current achievements of students "Platonus" (Automated educational process management system) at the ENU named after L.N. Gumilyov. After that, the results of the final control in the journal for each student are determined automatically.

4 students (30.77%) received final scores corresponding to the traditional "5" rating. 7 students (53.85%) received final scores corresponding to the traditional "4" rating. Two students (15.38%) have a traditional grade of "3". The implementation of the guaranteed training technology in the course "Economic and mathematical methods and models" in a group of Economics students allowed to get 100% academic performance and the quality of academic performance – 84.62%.

At the beginning of the research, the hypothesis, which was necessary to prove, was formulated: if in the conditions of credit system of education, involving the assessment system and the control of knowledge, the guaranteed training technology in the course "Economic and mathematical methods and models" is introduced in educational process, so the introduction of this educational technology will be effective.

The criteria for the effectiveness of guaranteed training technology are presented as follows:

1) interaction between teachers and students in the implementation of the guaranteed training technology;

2) creation of conditions for the implementation of creative activities of students and teachers by the guaranteed training technology;

3) ensuring the success by the guaranteed training technology in the activities of students and teachers;

4) self-analysis of students and teachers in the implementation of the guaranteed training technology;

5) self-development of students and teachers due to the possibilities of the guaranteed training technology;

6) the interconnection of the five parameters of the guaranteed training technology;

7) positive perception of the guaranteed training technology by students;

Table 1. The results of five diagnostics in the discipline "Economic and mathematical methods and models»

Studying	Diagnosis 1, score	Diagnosis 2, score	Diagnosis 3, score	Diagnosis 4, score	Diagnosis 5, score
1	74	74	86	74	74
2	74	86	98	86	95
3	74	90	94	93	89
4	92	88	90	89	90
5	74	50	56	77	74
6	74	89	78	77	49
7	50	89	67	72	74
8	60	60	62	74	50
9	100	100	100	100	100
10	89	75	58	93	80
11	75	75	97	84	74
12	60	60	89	86	50
13	74	75	90	75	89
Average score	74.6	77.8	81.9	83	76

8) criterion for reproducibility of the guaranteed training technology when used in mass practice.

To confirm the hypothesis, the feasibility of each criterion for the effectiveness of the guaranteed training technology should be checked.

1) According to the pedagogical technology of V.M. Monakhov, we have developed information maps of the lesson for the implementation of micro-goals for each technological map. They describe the interaction of teachers and students in the implementation of the guaranteed training technology. The tasks for practical training and independent work are selected in such a way as to prepare students for diagnostics, that is, assistance is provided to the student in the independent work as necessary. Current and mid-term control is also carried out. The first criterion for the effectiveness of the guaranteed training technology is met

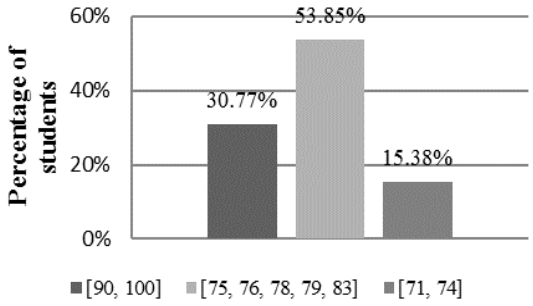

Figure 2 The results of the final control in the discipline "Economic and mathematical methods and models".

2) The second criterion of the guaranteed training technology is also met. Indeed, the introduction of V.M. Monakhov's pedagogical technology has shown that this technology provides the teacher with different types of work in the classroom, does not set limits, prohibitions and restrictions. Due to technological maps, students plan their academic activities and do not write down their homework during the class.

3) In the process of implementing the guaranteed training technology, the third criterion is met, since the student has the opportunity to correct the assessment after dosing the homework (actually reaches the standard level). Table 1 shows that there is no "unsatisfactory" rating for all five diagnostics. Thus, it is proved that this technology allows the teacher to evaluate and get a guaranteed final result.

4) The fourth criterion is fulfilled, i.e. there is reflection, since when choosing the level of training, the student analyzes his/her educational activities. As it was already noted, the student must reach the standard level, and then he or she either stops at this level, or claims a higher grade. After the lesson, the teacher also carries out the analysis of the project.

5) The introduction of the guaranteed training technology has confirmed that it gives students real opportunities for self-development:

- be able to organize the studies effectively;
- acquire analytical thinking skills;
- acquire the skills of research and independent work;
- evaluate his/her potential;
- ability to further development of his/her educational needs.

The teacher gets the opportunity to systematize the experience and improve the quality of work.

6) The work carried out on the introduction of the guaranteed training technology has shown a close interconnection between the five parameters of pedagogical technology.

7) Figure 1 shows an increase in average scores for four diagnostics. This indicates a positive perception of the guaranteed training technology by students, since this pedagogical technology guarantees not only that the level of knowledge of students meets the standard of education, but also comfortable conditions for students' learning.

8) The implementation of the guaranteed training technology in the course of economic and mathematical modeling in the educational process of one University will be useful when teaching this discipline on the basis of V.M. Monakhov's pedagogical technology in other economic universities.

The hypothesis put forward in the study is proved.

Table 2. The results of the final control in the discipline "Economic and mathematical methods and models»

Final scores	Number of students	Percentage of students
[90, 100]	4	30.77%
[75, 76, 78, 79, 83]	7	53.85%
[71, 74]	2	15.38%
In total	13	100%

4. DISCUSSION AND CONCLUSION

It has already been noted above that there is a similarity of statements of D.A. Vlasov and A.V. Babayan on the problem of creating a complete, logically consistent classification of pedagogical technologies. The author of the article developed and implemented in the educational process the guaranteed training technology in the course "Economic and mathematical methods and models", which is one of such pedagogical technologies and is used in various educational fields ("Economics", "Management", "Finance", etc.).

To find out how the guaranteed training technology in the course of economic and mathematical modeling adapts in the educational process, the author of the article conducted the research in 2018-2020. When implementing this technology, in the educational process technological maps, lesson information maps, and matrix testing at the exam are used. It should be noted that the role of this pedagogical technology is important in the formation and professional growth of novice teachers, since the compiled technological maps and a collection of information maps of classes will serve as a methodological guide for them. Having learned how to design a mathematical discipline using technology, they will gain experience in teaching this discipline.

The paper proves the research hypothesis about the effectiveness of the introduction of the guaranteed training technology for the course "Economic and mathematical methods and models". The results of the study showed 100% academic performance of students and the quality of academic performance – 84.62%.

Thus, the results of the study confirm that the offered by the author guaranteed training technology to the course "Economic and mathematical methods and models" is effective to help students acquire theoretical and practical teaching material, thus the possibility and expediency of its introduction in educational process of the University are grounded.

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